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TRILLIUM CUNEATUM RAF. IN TENNESSEE

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This is the tall, large-leaved, maroon or purple flowered, sessile wake robin found in moist woodland in most parts of Tennessee where it is usually common — probably being the most abundant purple-flowered *Trillium* in the state. It consists of a single, erect stem bearing a single sessile flower subtended by a whorl of three sessile leaves. The flower consists of three ascending sepals, three ascending petals, six straight and erect stamens, and an erect pistil with three stigmas.

Since there are several species of *Trillium* with sessile flowers and with sessile leaves, it might be profitable to compare briefly each of these with *T. cuneatum* as to differentiating characters. This task is attempted below.

DIFFERENTIATING CHARACTERISTICS

T. luteum (Muhl.) Harbison typically has yellow petals, yellowish stamens, and a yellow or greenish pistil. On the other hand, *T. cuneatum* typically has maroon or purple petals, brown or blackish-brown stamens, and a blackish-brown pistil. Intermediates between the two species occur with entirely purple petals and with yellow stamens and a yellow pistil. Other plants may have purple petals with dark brown or purple stamens and a yellow or green ovary. For the present, plants having any combination of the above with a yellow or green ovary are regarded here as belonging to *T. luteum*.

T. viride Beck has linear-lanceolate or oblanceolate definitely clawed green or purplish-green petals. The distal end of the stem and the veins in the basal part of the lower surface of the leaf are typically pubescent. The stamen connective is prolonged one millimeter or more beyond the anther sacs. I do not know *T. viride* from Tennessee. Typically, plants of *T. cuneatum* have unclawed purple petals, glabrous stems, glabrous under leaf surfaces, and stamen connectives prolonged less than one millimeter beyond the anther sacs. There are no specimens of *T. viride* from Tennessee in the herbariums of the University of Tennessee nor in those of Vanderbilt University.

It should be pointed out, however, that there are forms of *T. cuneatum* with scabrous veins on the under surface of the leaf and especially near the leaf base. Such specimens might readily be taken for *T. viride* except that the distal end of the stem in these forms is neither scabrous nor pubescent. Such

intermediate forms deserve more study than I have so far been able to give them.

T. viridescens Nutt. has conspicuously narrow, purple petals having claws 1.5-2.0 cm. long and blades narrowly linear-lanceolate or almost linear. I do not know this species from Tennessee. The petals of *T. cuneatum* are usually without claws and in no case with claws 1.5-2.0 cm. long nor with petal blades fully twice as long as the claws (as is the case in *T. viridescens*). In *T. cuneatum* the sepals are lanceolate to oblong. They are not linear.

T. lanceolatum Boykin has stamens with filaments about as long as the anthers and petals with definite claws at their bases. *T. cuneatum* has stamens with filaments 2.5-3.5 mm. long which is about one-fourth the length of the anther. The petals are usually unclawed.

T. ludovicianum Harbison has long linear or linear-lanceolate petals that are narrowed basally into long claws. Leaves are strongly mottled and ovate to broadly ovate in shape. Not known from Tennessee. *T. cuneatum* differs from it usually in having unclawed petals and weakly mottled leaves.

T. discolor Wray has obovate petals which usually have obtuse apices with one petal at least being apiculate. Sometimes, however, the petals are acute to acuminate without the apiculate point. The petals vary in color from a pale sulphur yellow to greenish. The petals of *T. cuneatum* are oblanceolate or elliptic in shape, non-apiculate, non-acuminate, and maroon or purple in color.

T. stamineum Harbison has linear and usually twisted purple petals which are horizontally placed in the flower. The distal end of the stem and the under surface of the leaf are pubescent (Shaver, 1957). The petals of *T. cuneatum* are erect and non-twisted, and the distal end of the stem and the lower surfaces of the leaf are not pubescent (but sometimes they are slightly scabrous).

Plate I. (See next page.) *Trillium cuneatum* Raf. (*T. Hugeri* Small). *A.* Broadly ovate leaves with some veining drawn, no. 3116. Drawings of the three sepals do not show veins but those of the petals show the more prominent veins. In the center of the flower are the stamens and the pistil. *C.* Two of the three ovate leaves are drawn subtending the sessile flower, no. 4168. Sepals are drawn without veins. The three petals are sketched rolled as is often the case late in the flowering season. Five of the six stamens are seen encircling the single pistil. This pistil is very representative of the group as to shape, size, wings. and erect stigmas with their tips slightly reflexed. *B.* An enlarged petal showing shape and some of the more prominent veins, mounted on sheet no. 4168 separate from flower *C.* The numbers given above are specimen numbers in the herbarium of Vanderbilt University.

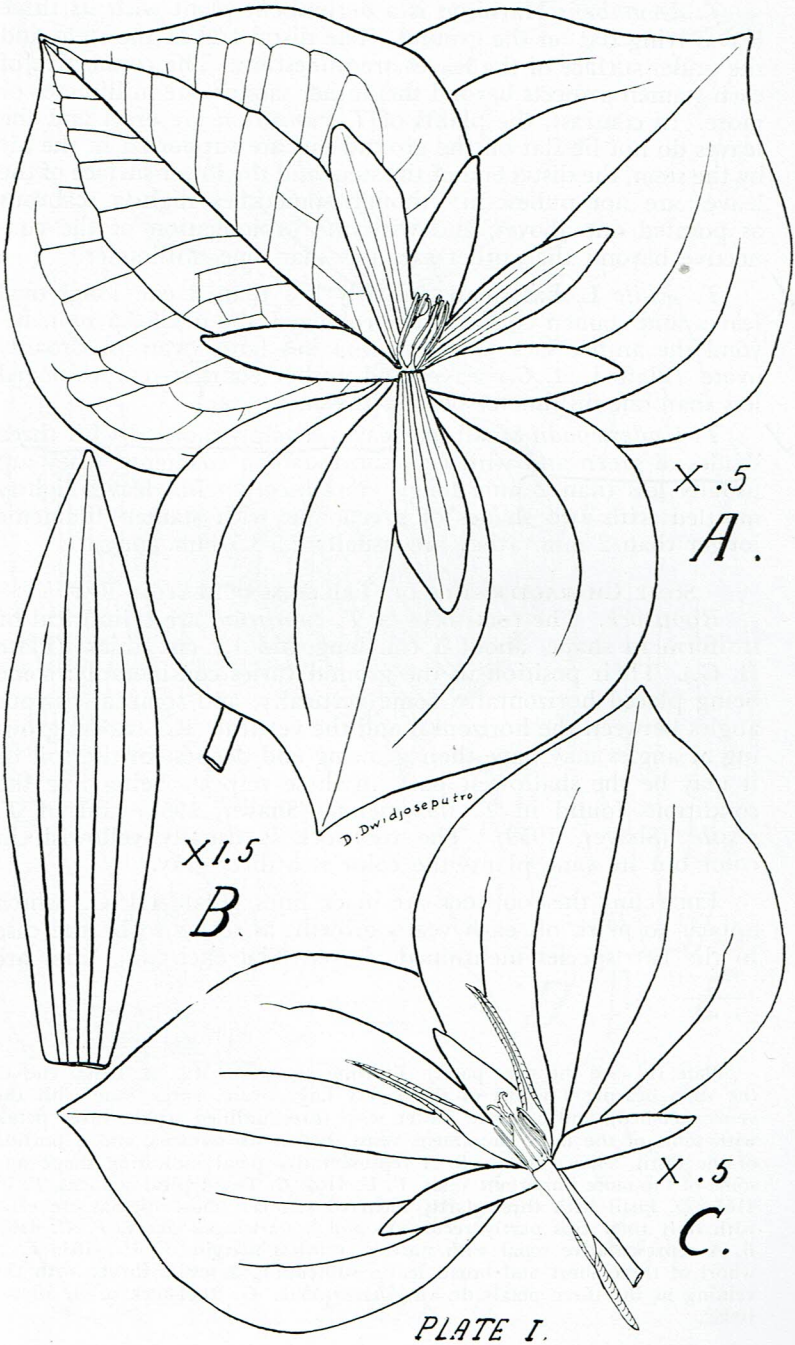

PLATE I.

T. decumbens Harbison is a decumbent plant with its three leaves lying flat on the ground. The distal end of the stem and the under surface of the leaves are pubescent. The connective of each stamen projects beyond the anther sac for one millimeter or more. In contrast, the plants of *T. cuneatum* are erect and the leaves do not lie flat on the ground but are supported in the air by the stem, the distal end of the stem and the lower surface of the leaves are not pubescent (though sometimes slightly scabrous as pointed out above), and with the prolongation of the connective beyond the anther sacs less than one millimeter.

T. sessile L. has small (usually less than 8 cm. long) oval leaves and stamen connectives prolonged about 2.5-3.5 mm. beyond the anther sacs. *T. cuneatum* has large ovate or broadly ovate (Plate I, *A, C.*) leaves and anther connectives prolonged less than one millimeter beyond the anther sacs.

T. Underwoodii Small has leaves strongly mottled with three shades of green and with very short stamen filaments (they are usually less than 2 mm. long). *T. cuneatum* has leaves lightly mottled with two shades of green and with stamen filaments longer than 2 mm. (they are usually 2.5-3.5 mm. long).

Some Characteristics of Trillium cuneatum Raf.

Rootstock. The rootstocks of *T. cuneatum* are cylindrical or fusiform in shape, about 5 cm. long and 1.7 cm. thick (Plate II, *G.*). Their position in the ground varies considerably: some being placed horizontally, some vertically, and some at various angles between the horizontal and the vertical. Rootstocks growing at angles may have their growing end deepest in the soil or it may be the shallowest part, in these respects being like the conditions found in *T. stamineum* (Shaver, 1957) and in *T. sessile* (Shaver, 1959). The rootstock is usually yellowish in color but in some plants the color is a dirty gray.

Encircling the rootstock are black lines (Plate III, *G.*) which appear to mark off each year's growth, as seems to be the case in the two species mentioned above. The encircling lines are

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Plate II. (See the next page.) *Trillium cuneatum* Raf. *A.* Distal end of the stem bearing a whorl of three very large ovate leaves (one with the veins sketched), and a sessile flower with three unlined sepals, three petals with some of the more prominent veins shown, six stamens, and a portion of the pistil, *Shaver* 10982. *B.* A representative petal indicating shape and some of the more important veins, *V. U.* 4167. *C.* Two typical stamens, *V. U.* 4167. *D.* Pistil with three partly recurved stigmas (most stigmas are erect with only their tips partly recurved), and a six-winged ovary, *V. U.* 4167. *B.* A representative sepal with narrow, veinless margin, *V. U.* 4168. *F.* A whorl of three short and broad leaves subtending a sessile flower with the veining in the three petals drawn, *Shaver* 5391. *G.* Rootstock of *A, Shaver* 10982.

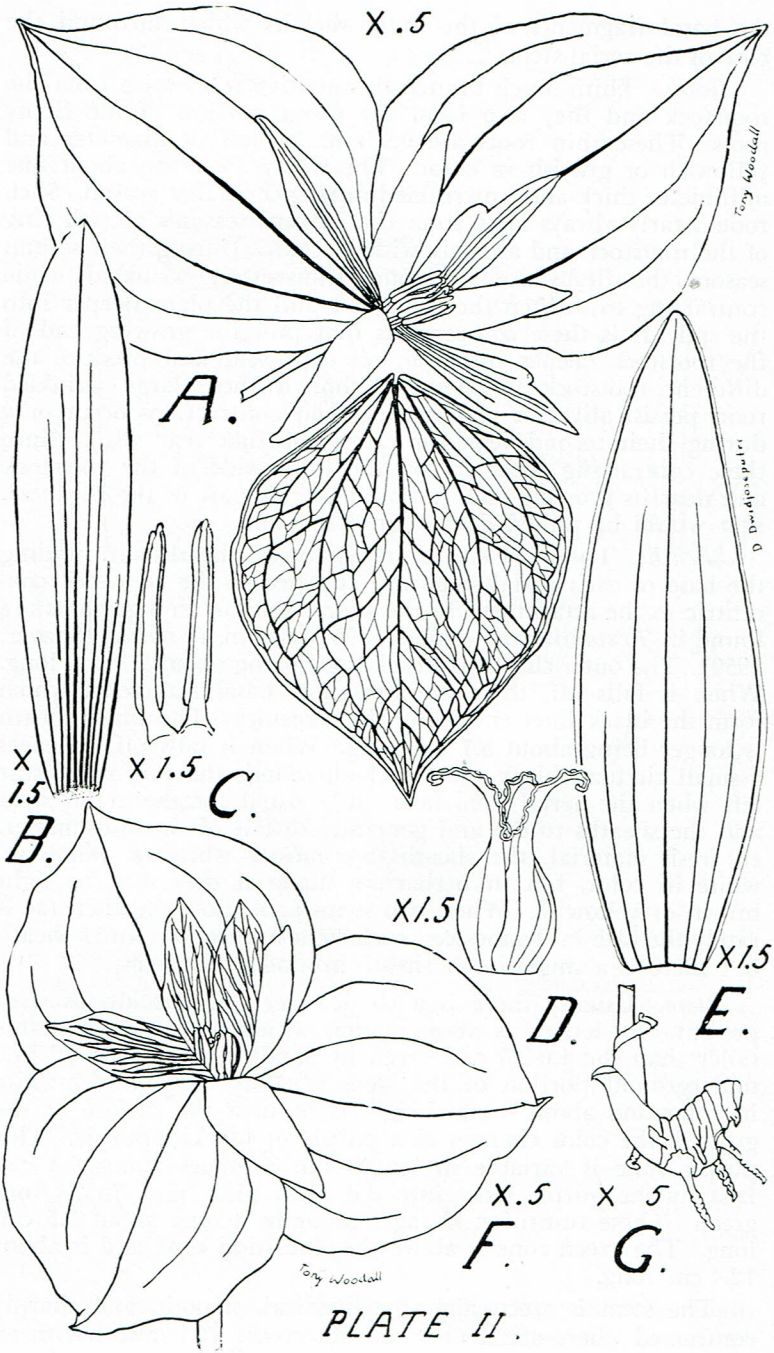

PLATE II.

the basal fragments of the outer sheaths which surround the base of the aerial stem.

Roots. Thin, much branched, nutritive roots arise from the rootstock and they also form the distal portion of the fleshy roots. These thin roots are 0.5 mm. or less in diameter and yellowish or grayish in color. The fleshy roots are about one millimeter thick and unwrinkled during their first season. Such roots nearly always arise from the current season's growth ring of the rootstock and are yellowish in color. During their second season, the fleshy roots become transversely wrinkled while contracting to shorten the roots and pull the plant deeper into the soil. It is these contractions that pull the growing end of the rootstock deeper into the soil each year and produce the different rootstock positions. Although these large wrinkled roots persist alive for many years, their contractions occur only during their second year (or rarely the first year also). Since these contracting roots are on the lower side of the rootstock and near its growing end, it would be this part of the rootstock that would be pulled deepest into the soil.

Sheaths. There are two main cylindrical sheaths surrounding the base of each aerial stem and attached to the rootstock concentric to the attachment of the stem. Similar arrangements are found in *T. stamineum* (Shaver, 1957) and in *T. sessile* (Shaver, 1959). The outer sheath is the shorter, being about 2.3 cm. long. When it falls off, there are left short basal fragments which form the black lines encircling the rootstock. The inner sheath is longer being about 5.7 cm. long. When it falls off, it leaves a small circular, black scar which surrounds the very small scar left when the aerial stem falls. It is usual for the aerial stem and the sheaths to die and generally to fall off in midsummer. In fresh material, the sheaths are mostly white or yellowish-white in color, but in herbarium material they may be light brown or yellowish. When two stems arise close together (as is rarely the case in Tennessee), each stem has its own inner sheath but there is a single outer sheath around both stems.

Stem. Usually there is a single, erect and deciduous stem present. Its length is about 3 dm. which makes these plants taller than the 1.0-2.5 dm. given by Small (1933, p. 307). The underground portion of the stem is white or yellowish-white in color and about 6 cm. long. At or near the surface of the ground, the color changes to a purple or blackish-purple. This purple zone is variable in length but averages about 5.3 cm. Distally the purple fades into red, then pink, and finally into green. These transition changes occur in a zone about 3.5 cm. long. The green zone is above the transition zone and is about 12.4 cm. long.

The stem is erect, almost cylindrical, smooth, and sharply contracted where attached to the rootstock. It is also narrowed

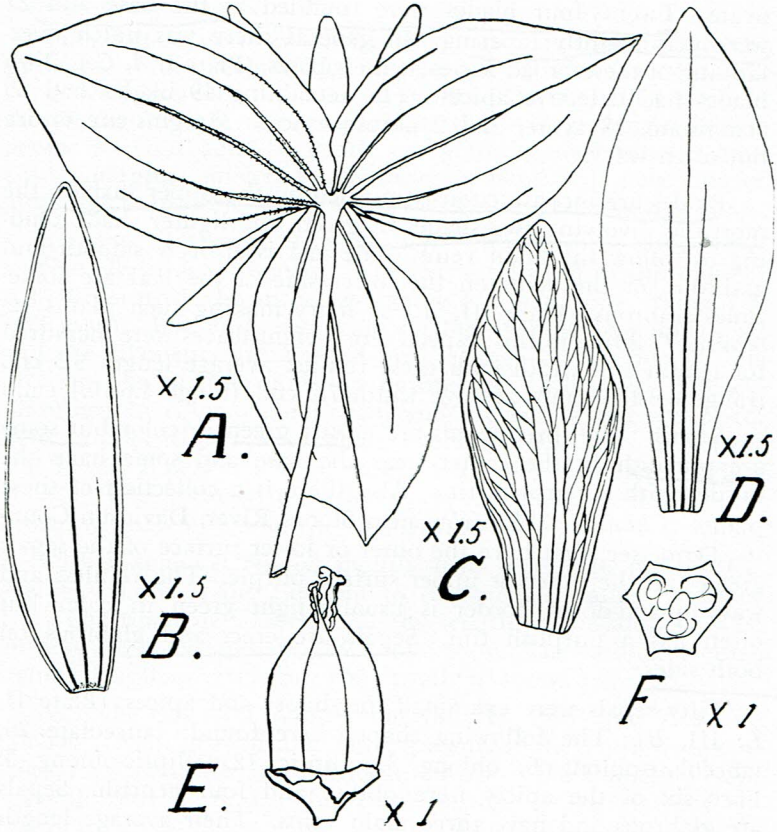

Plate III. Some details of *Trillium cuneatum* Raf. *A*. The distal end of the stem and the lower surfaces of the leaves. The stem is smooth and glabrous; the leaves scabrous on the larger veins (indicated on one leaf only), *Shaver* 5405. *B*. Sepal showing the three main veins and the narrow, veinless border. *V.U.* 4167. *C*. Petal to show veining, *Shaver* 10979. *D*. Petal showing base narrowed almost to a claw, *V.U.* 4164. *E*. An almost mature fruit, fresh material, July 6, 1959. *F*. Section through an almost mature fruit, fresh material, July 6, 1959.

into a neck a short distance below the leaves. The thickness in the neck region is about 3.6 mm. and in the purple zone (greatest diameter) about 5.5 mm.

Leaves. A whorl of three sessile leaves subtends the single terminal flower. To determine shape, 51 leaves were examined

with these results: 42 were oval or broadly oval and 9 were ovate. Twenty-four blades were rounded at the base and 27 were very slightly tapering. In general there was much overlapping of these broad leaves at their bases (Plate I, *A. C.*). Two blades had defective apices. The remaining 49 blades had 29 acuminate, 18 acute, and 2 obtuse apices. Margins are entire but often wavy.

Blades are inconspicuously mottled on the upper surface, the mottling involving two shades of green, the lighter shade tending to follow the main veins. The leaf is entirely smooth and glabrous, or the veins on the lower side of the leaf are sometimes scabrous (Plate III, *A.*) or hairy making such plants resemble *T. viride* in this respect. Forty-eight leaves were measured for length and width with these results: average length 9.5 cm. (range 6.8-13.0 cm.), average width 7.2 cm. (range 4.6-10.1 cm.).

Sepals. The three sepals are mostly green in color but some are purplish in the center near the base and some have the border with a purplish tint. Also there is a collection of these plants (*Channell* 7156) from near Stones River, Davidson County, Tennessee, that have the outer or lower surface of the sepals green and the inner or upper surface purple. The veinless and wavy-up-and-down border is usually light green in color but often has a purplish tint. Sepals are erect and glabrous on both sides.

Fifty sepals were examined for shapes and apices (Plate II, *E;* III, *B*). The following shapes were found: lanceolate 26, lanceolate-oblong 6, oblong 3, elliptic 12, elliptic-oblong 3. Forty-six of the apices were obtuse and four acutish. Sepals are glabrous and have three main veins. Their average length is 4.4 cm. (ranging from 3.3 to 5.7 cm.) and the average width 1.1 cm. (range: 0.6-1.5 cm.). The ratio of average width to average length is 1:4. The sepals are persistent, remaining attached to the receptacle even after the fall of the fruit.

Petals. The petal whorl is composed of three erect and distinct petals so aranged that the petals alternate with the sepals. The petals tend to arch over the stamens and pistil. With age the petals die and dry up, becoming brittle so they may break away leaving basal fragments behind. Usually the petals are a rich reddish purple in color but they may be brown or light brown. Most of the petals are oblanceolate or elliptic in shape but some are obovate and a few oblong or elliptic-oblong (Plate I, *B;* II, *B;* III, *C, D*). About 80% of the petals have obtuse apices but the rest have acutish apices. Some of the long slender petals are rolled to make slender cylinders (Plate I, *C*). Most petals are narrowed at their base but do not have definite claws.

However, two plants (*V.U.* 4161, *V.U.* 4164) have definite though short claws.

Fifty petals were measured for length and width and the following results secured: average length 4.9 cm. (range 3.9-7.2 cm.), average width 1.2 cm. (range 0.7-2.2 cm.). The ratio of the average length of the sepals to the average length of the petals is about 1.0:1.1. Petals are glabrous and usually have entire margins. Sometimes, however, a petal will have one or more indentations to form one or two shallow lobes (Plate II, *A*).

Stamens. Just central to the petal whorl are the six distinct and nearly straight stamens. The average length of the stamens is 14.4 mm. with the anther averaging 11.6 mm. long (range 7.5-14.4 mm.). The anther sacs are on the average 11.3 mm. long and the filaments average 2.8 mm. (range 2.5-3.5 mm.). The prolongation of the connective beyond the anther sacs is blackish-brown in color, cone-shaped, and arched toward the pistil. This prolongation is very small, averaging 0.33 mm. in length and never, I believe, being longer than one millimeter (Plate II, *C*). The connective between the anther sacs is blackish-brown in color as is also the filament.

Each filament flares out slightly at its base. The ratio of the average length of the filament to the average stamen is about 1:5. The filament is about 1/4 the length of the anther. The anthers are linear and about 2.5 mm. wide. The ratio of average stamen length to average petal length is about 1.4.

As is the case in *T. stamineum* (Shaver, 1957) and *T. sessile* (Shaver, 1959), growth and development of the fruit is accompanied by the death and drying up of all of the stamens except a small basal portion. This basal portion of the stamens enlarges by growth. It could well be that this growth increase is important in helping the fruit to fall off of the receptacle. Along with the growth of the stamen bases, are color changes in these bases. The brownish-purple color becomes red, then pink, and finally a whitish-green.

Pistil. Each flower has a single erect and distinct pistil consisting of an ovoid or fusiform blackish-brown or sometimes a very black ovary with a bluish tint, surmounted by three blackish-brown, linear and sessile stigmas. The stigmas are usually erect with their tips bent outward. Plate II, *D* is of a pistil with the stigmas spread out much more than is usually the case. The stigmatic area is centrally placed, blackish or sometimes whitish-yellow in color, and irregularly corrugated. The stigmas average about 7.3 mm. in length, and surmount the ovary. The ovary has six longitudinal wings in three groups of two each. Each pair of wings converge on each stigma where they coalesce. The ovary itself is about 6.1 mm. thick and about 8.9 mm. long.

Fruit. The size of the mature fruit may depend in part on the number and stage of development of the seeds. If many seeds develop, the fruit fills out well and the wings become ridges (Plate III, *E*). Immature fruits are brown with six very prominent wings which come together in three pairs, and then each pair fuses into a single structure in each stigma. If there are only a few seeds or if most of the seeds fail to develop, this winged condition may remain in the mature fruit. When the fruit is mature, it falls off from the receptacle leaving behind a small, circular, white scar. At Nashville, this falling of the fruit usually occurs between July 1 and 10.

When the fruit has many seeds and the seeds develop well, the fruit may so fill up as to reduce the wings to small ridges. Such mature fruit may be 3 cm. long, 2 cm. thick, ellipsoid, and green with the distal ends of the ridges retaining some of the purple color. The three stigmas persist in the fruit as black dried-up mummies. The fallen fruit is indehiscent but it is usually partly open at the base where it was formerly attached to the receptacle.

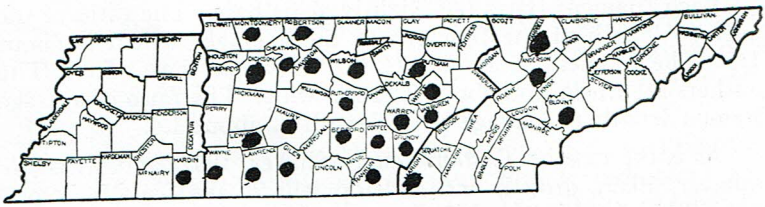

Fig. 1. The present known county distribution of *Trillium cuneatum* in Tennessee. Based on specimens in the herbariums of the University of Tennessee, of Vanderbilt University, and of the author.

Seeds. Seeds vary greatly in number per berry. They are yellow in color, usually ovoid or ellipsoid in shape, 2.5 mm. in thickness, and about 3.5 mm. long. There is a white aril over one end of each seed, which makes it difficult to measure seed length acurately, for in fresh material the aril is large and spongy, and in harbarium material seeds are often absent or scarce. When found, the aril is seen to be dried up and plastered to the seed.

Summary of Taxonomic Characteristics of T. cuneatum in Tennnessee

Stem erect, smooth, about 3 dm. high; *leaves* sessile, broadly oval or ovate, acuminate or acute apices, rounded or slightly tapering base, usually weakly mottled, glabrous or slightly scabrous at distal end of stem (rare) and on large veins of lower

surface of leaves, 6.8-13.0 cm. long, 4.6-10.1 cm. broad; *sepals* usually lanceolate and obtuse, 3.3-5.7 cm. long; *petals* sessile, 3.9-7.2 cm. long, 0.7-2.2 cm. broad, reddish purple to brown, to yellowish green, clawless or *with a very short claw; stamens* about one-fourth (not one-third as given by Fernald, 1950) the length of the petals, *filaments* 2.5-3.5 mm. long, tapering from a broad base, *anther* 7.5-14.4 mm. long, the *anther-connective* very short (averaging 0.33 mm. in my material); *pistil* blackish-brown with three sessile and erect stigmas except for their tips which are bent outward; *mature fruit green* or sometimes with some purple on the ridges.

Distribution

The general distribution of *T. cuneatum* is given by Fernald (1950) as " . . . nw. Fla. to Miss. n. to upland of N. C. and Ky." In Tennessee, this trillium appears to be most common in Middle Tennessee. However, this may be due to more spring collection here and less collecting in East and in West Tennessee.

Acknowledgments

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